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SUBJECT

PHYSICAL PERFORMANCE OF PAINT PRIMERS

Prepared by: C. D. Holley
F. M. Nelson

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ALLIED RESEARCH LABORATORIES

CHICAGO, ILLINOIS

Physical Performance of Paint Priners

General Statement. Very little is known of the physical performance of paint priners and undercoaters on application to wood surfaces. The following data was obtained to furnish information which could be used in publicizing the superiority of 450 Undercoater.

It is recognized that the figures given in the following tables are not fixed quantities, but will vary somewhat according to the porosity of the wood on which the paints are applied. By selecting a well known type of wood of medium porosity - White Pine - we obtained a reasonable basis of comparison.

It is natural to think of the composition of an applied Paint Primer or Finish Coat as being similar in composition to the formulas from which made. The results given herewith show that the dried paint films can be quite different.

Purpose. The purpose of this investigation was to ascertain the effect of different oils and pigments, as to amount of the oil retained in the film and the amount absorbed into the wood and finally the same information with a number of different types of ready to use Primers. Such information should furnish an excellent background for future changes in Paint Primer formulations.

Procedure. Rex 450 - SWP Undercoater was taken as the basic formula. The Primers were spread at 500 sq. ft. per gallon on selected White Pine. The paints in each group were applied on the same board, allowed to stand for about five hours or until the paint became pasty. The paint then removed and the residual oil content determined and the amount of oil absorbed calculated. The application of the Finish Coats over the Primers was at 625 feet per gallon and the residual oil contents determined as above, the Primer being allowed to dry two days.

Certain difficulties were experienced in determining the individual performance of two constituents of the 450 Undercoater. The Amorphous Silica, 1552 dry, would not mix or grind satisfactorily alone, hence was determined in admixture with Asbestine and then the Asbestine separately, from which an approximation of the behavior of the Silica was calculated.

It became necessary to deal with the (2281), a bodied Tung Oil, in a similar manner, because of rapid surface drying after application. Its behavior in combination with Linseed Oil was determined and a calculated value obtained.

Effect of Polymerized Oils

It has been commonly believed that there was a marked degree of selective absorption on wood surfaces, of polymerized oils as compared with raw oils, the polymerized oils having little penetration.

This may be true where the oils are present in large volumes per unit of area of application. On a paint primer coating where a substantial volume of the oil is bound to the pigment, there is only sufficient "free" oil to penetrate the wood to the depth of 1 or 2 one-thousandths of an inch. In this short distance, there appears to be only a very limited selective absorption, almost none with Linseed and some with Tung Oil.

An admixture of 50 parts of a 12 minute bodied Linseed with 50 parts Raw Linseed applied in thin layer on White Pine after a two hour period, showed a composition of 52 parts bodied oil to 48 parts raw oil as determined by change in Refractive Index. A similar test was made barely saturating saw dust and removing a small portion of the oil with hydraulic pressure. The results were similar to those above. It is possible that the presence of pigments might have influenced the selective absorption.

The calculated value obtained for Tung Oil (see table 3) shows a definite degree of selective absorption. Very little difference was observed between Raw Linseed Oil and the mildly bodied (785).

Behavior of Different Primer Types. Table 1 shows the relative performance of different types of primers compared with White Lead in Oil, SWP - Outside White, and a Krebs paint as reduced for first coat work.

The results show that the wood surface could easily take up much greater quantities of oil than were taken up from the prepared Primers, indicating that in primer formulation we should consider two kinds of oil - "free" oil and "bound" oil. The final Pigment Volume Relationship of White Lead and of SWP being similar to that of the various Primers.

Table 1
Paint Primers
Distribution of Oil Between Wood and Paint Film

Formula	Total Oil Per 100 Gals.	Gals. Abs.	Gals. in Film	Gals. Pigment	P.V.C. Paint	P.V.C. Film	% Oil Abs.	Vol. of Film - Gals.
Krebs' 1st coat	68.3	50.5	17.8	18.1	21.0%	50.5%	74.0%	35.9
SWP Outside White 1st coat reduction	66.6	49.5	17.1	19.1	22.3%	53.0%	74.4%	36.2
White Lead in Oil 1st coat	58.5	45.7	12.8	17.9	23.0%	58.0%	78.0%	30.4
New Jersey Zinc Primer	58.9	35.0	23.9	25.6	30.2%	51.7%	59.5%	49.5
450 Undercoater	47.3	25.1	22.2	25.7	35.2%	53.7%	53.0%	47.9
Lowe's Primer	46.5	28.6	17.9	23.9	33.9%	57.2%	61.5%	41.8
MW 401 (Devoe Type)	39.7	22.2	17.5	25.8	39.6%	59.5%	55.8%	43.3

It is interesting to note that the relation of oil to pigment in the 450 Undercoater paint film is similar to that of the film of SWP White reduced for first coat work or 54 to 55 (Pig. Vol. Rel.).

It is also worthy of note that the 450 Undercoater retains more oil in the film and gives more to the wood than the Devoe type of Primer and presumably imparts a greater margin of safety to the 450 Undercoater to meet varying types of wood surfaces, as contributing to durability.

The 450 Undercoater at a spreading rate of 500 sq. ft. per gallon has about 10% greater "build" - thickness of film - than Devoe and about 13% more than Lowe Brothers. (See last column.)

The New Jersey Zinc Primer based on 85% MS-150 and 15% Leaded Zinc as the pigment and with 75% of the total oil as a medium bodied Tung - Linseed Oil shows an excellent build, an excellent relationship between oil absorbed and oil retained. In comparative exposure tests it has shown better durability than the Devoe type of Primer.

Adequate film thickness in a 2 coat system is vitally important. S-W's 450 Undercoater is the only commercial Primer we have found which has the required "build" accompanied by the proper through drying of the film.

Behavior of Individual Pigments. Taking Rex 450 as the basic formula, the performance of individual pigments was observed, in which the volume of the given pigment used was the same as of the combined pigments in Rex 450.

Table 2.
Effect of Individual Pigments in 450 Undercoater Type of Formulation

Pigment	Total Oil per 100 Gals.	Gals. Abs.	Gals. in Film	Gals. Pig-ment	P.V.C. in Paint	P.V.C. in Film	% Oil Absorbed
Titanox B	47.3	26.7	20.6	25.7	35.2%	55.6%	56.5%
White Lead	47.3	22.5	24.8	25.7	35.2%	50.8%	47.5%
Leaded Zinc 35/65	47.3	21.0	26.3	25.7	35.2%	49.5%	44.4%
Asbestine	47.3	13.72	33.58	25.7	35.2%	43.0%	29.0%
Asbestine - 75%) Amorphous Silica - 25%)	47.3	14.75	32.55	25.7	35.2%	43.3%	31.2%
Amorphous Silica (calc.)	47.3	17.9	29.4	25.7	35.2%	46.6%	37.8%
Titanium Oxide	47.3	5.91	41.39	25.7	35.2%	38.8%	12.5%

The similarity of performance on an equivalent volume basis of White Lead and Ozlo Leaded Zinc 35/65 is particularly noticeable.

The high oil retaining characteristic of Titanium Oxide in the film is a factor of importance.

The recent replacement of 25% of the Asbestine with Amorphous Silica shows little effect as to oil performance.

Effect of Individual Oils. The effect of polymerization was discussed briefly under a previous caption. The individual oils examined are those which are used in S-W 450 Undercoater and may not be representative of the action of other oils. Also in each case there is present the same volume of volatile thinners as are present in Rex 450.

Table 3
Effect of Oils in 450 Undercoater Type of Pigmentation

Vehicle	Total Oil per 100 Gals.	Gals. Abs.	Gals. in Film	Gals. Pig-ment	P.V.C. in Paint	P.V.C. in Film	% Oil Absorbed
Combined Vehicle							
Rex 450	47.3	25.1	22.2	25.7	35.2%	53.7%	53%
(2)	47.3	27.4	19.9	25.7	35.2%	56.3%	58%
(785)*	47.3	26.5	20.8	25.7	35.2%	55.2%	56%
(2) 45% (2281) 55%	47.3	23.2	24.1	25.7	35.2%	51.6%	49%
(2281) (Calc.)**	47.3	19.9	27.4	25.7	35.2%	48.3%	42%
(2)	50.3	29.8	20.5	25.7	33.8%	55.5%	59.2%
(785)	50.3	29.7	20.6	25.7	33.8%	55.5%	59.0%

*Slightly heat bodied Linseed Oil.

**Strongly bodied Tung and Perilla Oil.

The performance of the Raw Linseed Oil (2) and slightly heat bodied Linseed Oil (785) is almost identical.

The bodied Tung Oil (22P1) by calculation shows considerably less absorption into the wood than either of the preceding oils and can be used to change to some degree the ratio of "bound" to "free" oil.

The last two results shown on this table were obtained on another board and with the use of 1/16 more oil. It is to be noted that the oil retained in the paint films is similar to that shown by (2) and (785) in the upper portion of the table, giving the same Pigment Volume Relationships in the film.

Absorption of Oil From Finish Coat Into Priming Coat. Experience has shown that some oil in the Finish Coat migrates into the Undercoat, or through it into the wood below, leaving flat spots, especially if the undercoat and finish coat represent a self-primed system.

The following table indicates that a relatively small amount of oil leaves the Finish Coat, providing that the spreading rate of the priming coat is held down to a point giving an adequate build or thickness of film, thus preventing the oil from passing through the Primer into the wood.

The Pigment Volume Concentration of SWP White and 450 Undercoater in the films are almost identical (see Table 1) and the Devoe type not greatly different, hence material differences in oil absorption from the Finish Coat would not be expected.

Table 4
Absorption of Oil From Finish Coat by Priming Coats

	Top Coat	Total Gals. Oil/100 Gals.	Gals. Abs.	Gals. Left	% Abs.	Orig. P.V.C.	P.V.C. Film
SWP - Outside White	Rex 471	66.5	4.25	61.25	6.4%	28.4%	29.7%
450 Undercoat	Rex 471	66.5	3.86	62.64	5.8%	28.4%	29.6%
MW 401 (Devoe Type)	Rex 471	66.5	4.25	61.25	6.4%	28.4%	29.7%

The last two columns show the change in the Finish Coat as applied and after absorption into the Primer. This absorption obviously lowers the Pigment Volume Concentration in the priming coats as follows:

Priming Coat	Before	After
SWP - White	55%	47%
450 Undercoat	54%	50%
MW 401 (Devoe type)	59%	54%

The dried prime coats were very low in "sheen" but after the Finish Coat had been applied and removed the 450 Undercoater and Devoe type had a medium and uniform oil gloss, the SWP White a low, not uniform gloss.

Conclusions. From the results obtained in this investigation there are good grounds for believing that from a physical performance viewpoint, we are in a well balanced condition and any changes should be of a minor nature.

Also there are grounds for believing the 450 Undercoater is in a better balanced condition as to performance than the leading competitive Primers on the market.

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